PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter I of the Patent Cooperation Treaty)

(PCT Rule 44*bis*)

Applicant's or agent's file reference 15670-029WO1	**FOR FURTHER ACTION**	See item 4 below
International application No. PCT/US2004/017237	International filing date *(day/month/year)* 01 June 2004 (01.06.2004)	Priority date *(day/month/year)* 30 May 2003 (30.05.2003)]
International Patent Classification (IPC) or national classification and IPC [7] G06F 17/50		
Applicant THE REGENTS OF THE UNIVERSITY OF CALIFORNIA		

1. This international preliminary report on patentability (Chapter I) is issued by the International Bureau on behalf of the International Searching Authority under Rule 44 *bis*.1(a).

2. This REPORT consists of a total of 8 sheets, including this cover sheet.

   In the attached sheets, any reference to the written opinion of the International Searching Authority should be read as a reference to the international preliminary report on patentability (Chapter I) instead.

3. This report contains indications relating to the following items:

☒	Box No. I	Basis of the report
☐	Box No. II	Priority
☐	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
☐	Box No. IV	Lack of unity of invention
☒	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
☐	Box No. VI	Certain documents cited
☒	Box No. VII	Certain defects in the international application
☐	Box No. VIII	Certain observations on the international application

4. The International Bureau will communicate this report to designated Offices in accordance with Rules 44*bis*.3(c) and 93*bis*.1 but not, except where the applicant makes an express request under Article 23(2), before the expiration of 30 months from the priority date (Rule 44*bis* .2).

	Date of issuance of this report 01 December 2005 (01.12.2005)
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Form PCT/IB/373 (January 2004)

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

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PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing (*day/month/year*)	17 DEC 2004
Applicant's or agent's file reference 15670-029WO1	FOR FURTHER ACTION See paragraph 2 below

International application No.	International filing date (*day/month/year*)	Priority date (*day/month/year*)
PCT/US04/17237	01 June 2004 (01.06.2004)	30 May 2003 (30.05.2003)

International Patent Classification (IPC) or both national classification and IPC

IPC(7): G06F 17/50 and US Cl.: 716/5

Applicant

THE REGENTS OF THE UNIVERSITY OF CALIFORNIA

1. This opinion contains indications relating to the following items:

- ☒ Box No. I — Basis of the opinion
- ☐ Box No. II — Priority
- ☐ Box No. III — Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV — Lack of unity of invention
- ☒ Box No. V — Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI — Certain documents cited
- ☒ Box No. VII — Certain defects in the international application
- ☐ Box No. VIII — Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(*b*) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA/ US	Authorized officer
Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450	Matthew Smith for James R. Matthews
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Form PCT/ISA/237 (cover sheet) (January 2004)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US04/17237

Box No. I Basis of this opinion

1. With regard to the language, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ This opinion has been established on the basis of a translation from the original language into the following language _____, which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).

2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:

a. type of material

☐ a sequence listing

☐ table(s) related to the sequence listing

b. format of material

☐ in written format

☐ in computer readable form

c. time of filing/furnishing

☐ contained in international application as filed.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US04/17237

Box No. V Reasoned statement under Rule 43 *bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims 12-13	YES
	Claims 1-11, 14-26	NO
Inventive step (IS)	Claims 12-13	YES
	Claims 1-11, 14,-26	NO
Industrial applicability (IA)	Claims 1-26	YES
	Claims NONE	NO

2. Citations and explanations:

Please See Continuation Sheet

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US04/17237

Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

Claims 23 are objected to under PCT Rule 66.2(a)(iii) as containing the following defect(s) in the form or contents thereof: There is 2 claim 23s and no claims 24. One of the claims 23 needs to be renumbered to be claim 24.

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US04/17237

Supplemental Box
In case the space in any of the preceding boxes is not sufficient.

V. 2. Citations and Explanations:

Claims 1-26 lack novelty under PCT Article 33(2) as being anticipated by Kozhaya et al, "A multigrid-like technique for power grid analysis", Computer-Aided Design of Integrated Circuits and Systems, IEEE Transactions on, Volume: 21 , Issue: 10, Oct. 2002, Pages:1148 - 1160.

In reference to claim 1, Kozhaya teaches a method comprising: representing a circuit network by using a matrix of nodes having fine nodes and coarse nodes; applying an adaptive coarse grid construction procedure to assign grid nodes in the matrix as either coarse grid nodes or fine grid nodes according to (1) circuit activities and (2) to a matrix structure of the matrix to construct a plurality of levels of grids with different numbers of nodes to respectively represent the circuit network; and applying iterative smoothing operations at selected local fine grids corresponding to active regions at a finest level obtained in the adaptive coarse grid construction procedure. (page 1153, column 2 - page 1156, column 2)

In reference to claim 2, Kozhaya teaches wherein the coarse grid nodes are divided into non-adaptive coarse nodes which are selected according to the matrix structure, and adaptive coarse nodes which are selected according to circuit activities. (page 1154, column 2 - page 1155, column 2)

In reference to claim 3, Kozhaya teaches wherein, in assigning non adaptive coarse nodes, a node with a maximum potential in its degree is selected as a first non-adaptive coarse node and each neighboring node of the first non-adaptive coarse node is temporality assigned as a fine node, and wherein a potential of each neighboring node of the first non-adaptive coarse node is increased by one unit before a next level of assigning coarse and fine grid nodes so that each fine node has at least one neighboring coarse node upon completion of assigning non adaptive coarse nodes. (page 1154, column 2 - page 1155, column 2)

In reference to claim 4, Kozhaya teaches wherein an adaptive coarse node is selected according to a first-order derivative of a nodal voltage. (page 1154, column 2 - page 1155, column 2)

In reference to claim 5, Kozhaya teaches wherein a coarse node is selected as an adaptive coarse node when the first order derivative the coarse node is greater than a threshold value. (page 1154, column 2 - page 1155, column 2)

In reference to claim 6, Kozhaya teaches selecting adaptive coarse nodes in a level that is not the finest level. (page 1154, column 2 - page 1155, column 2)

In reference to claim 7, Kozhaya teaches applying a restriction mapping of nodes in the level to a next level with less nodes; performing iterative smoothing operations again at the next level; and repeating the restriction mapping and the iterative smoothing operations until reaching a level of nodes which are solvable by a direct matrix solving method. (page 1152, column 2 - page 1153, column 2)

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INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US04/17237

Supplemental Box
In case the space in any of the preceding boxes is not sufficient.

In reference to claim 8, Kozhaya teaches applying an interpolation mapping of nodes in the level to a next level with more nodes; performing iterative smoothing operations again at the next level; and repeating the interpolation mapping and the iterative smoothing operations until reaching the finest level of nodes. (page 1155, column 2 - page 1156, column 2)

In reference to claim 9, Kozhaya teaches computing a residual value of an error after the iterative smoothing operations at the finest level; comparing the residual value to a pre-determined threshold; terminating any further processing when the residual value is less than the threshold; and when residual value is greater than the threshold, the method further comprising: applying a restriction mapping of nodes in the finest level to a next coarser level with less nodes, performing iterative smoothing operations again at the next coarser level; and repeating the restriction mapping and the iterative smoothing operations until reaching a coarsest level of nodes which is solvable by a direct matrix solving, applying an interpolation mapping of nodes in the coarsest level to a next finer level with more nodes, performing iterative smoothing operations at the next finer level, repeating the interpolation mapping and the iterative smoothing operations until reaching the finest level of nodes, and repeating the restriction mapping, the interpolation mapping and the respective iterative smoothing operation at different levels until the residual value at the finest level is less than the threshold. (page 1152, column 2 - page 1155, column 2)

In reference to claim 10, Kozhaya teaches dynamically changing designations of active and inactive regions of the circuit network according to circuit activities at different times. (page 1154, column 2 - page 1155, column 2)

In reference to claim 11, Kozhaya teaches applying iterative smoothing operations in active regions more frequently in time than in inactive regions. (page 1154, column 2 - page 1155, column 2)

In reference to claim 14, Kozhaya teaches a method comprising: representing a circuit network by using a plurality of levels of grids with different numbers of nodes to represent the circuit network according to an algebraic multigrid method; applying a restriction mapping from one level to a next coarser level to propagate computation results of the one level to the next coarse level; applying an interpolation mapping from one level to a next finer level to propagate computation results of the one level to the next finer level; performing an iterative smoothing operation at each level to obtain computation results of each level comprising states of nodes in each level; and repeating (1) the restriction mapping and the iterative smoothing operation from the finest level to the coarsest level and (2) the interpolation mapping and the iterative smoothing operation from coarsest level back to the finest level for at least one time to obtain a solution to the circuit network. (page 1153, column 2 - page 1156, column 2)

In reference to claim 15, Kozhaya teaches wherein the coarsest level is a level where a matrix equation for nodes in the level is solvable by a direct matrix method (page 1152, column 2 - page 1153, column 2)

In reference to claim 16, Kozhaya teaches wherein at least one level includes nodes corresponding to only selected circuit regions in the circuit network that are active and does not include nodes corresponding to inactive circuit regions in the circuit network. (page 1154, column 2 - page 1155, column 2)

In reference to claim 17, Kozhaya teaches assigning regions in the finest level with nodes corresponding to active circuit regions in the circuit network
as active local fine grids; and performing the iterative smoothing operation only in the active local fine grids in the finest level to obtain computation results of the finest level. (page 1154, column 2 - page 1155, column 2)

In reference to claim 18, Kozhaya teaches assigning regions in a level with nodes corresponding to active circuit regions in the circuit network as active local grids and other regions in that level as in inactive grids; and performing the interactive smoothing operation in an active local grid more frequently than in an inactive grid. (page 1154, column 2 - page 1155, column 2)

In reference to claim 19, Kozhaya teaches applying an adaptive coarse grid construction procedure to assign grid nodes in the matrix as either coarse grid nodes or fine grid nodes. (page 1154, column 2 - page 1155, column 2)

In reference to claim 20, Kozhaya teaches wherein a coarse node is assigned by: assigning a node with a maximum potential to its degree as a first coarse node and all neighboring nodes as initial fine nodes; for each of the initial fine nodes, increasing a potential of each of neighboring nodes by one unit; assigning a node which has a maximum potential among other nodes except for the first coarse node as a second coarse node; and repeating the assigning for nodes that are not assigned as coarse nodes until all nodes are assigned. (page 1154, column 2 - page 1155, column 2)

In reference to claim 21, Kozhaya teaches wherein the coarse nodes are selected according to their values of a first order derivative of a nodal voltage. (page 1154, column 2 - page 1155, column 2)

In reference to claim 22, Kozhaya teaches a method comprising: applying an algebraic multigrid method to a matrix representative of a circuit network to construct a plurality of matrices with different degrees of coarsening grids; representing regions in the circuit network exhibiting to active circuit activities with active grids and regions in the circuit network exhibiting less active circuit activities

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

Supplemental Box
In case the space in any of the preceding boxes is not sufficient.

with inactive grids; and performing an iterative smoothing operation in an active grid more frequently than in an inactive grid to reduce an amount of computation. (page 1153, column 2 - page 1156, column 2)

In reference to the first claim 23, Kozhaya teaches applying a restriction mapping of nodes in a coarse grid to a next coarser grid; performing the iterative smoothing operation at the next coarser grid; and repeating the restriction mapping and the iterative smoothing operation until reaching the coarsest grid which has a matrix equation that is solvable by a direct matrix solving method (page 1152, column 2 - page 1153, column 2)

In reference to the second claim 23, Kozhaya teaches applying an interpolation mapping of nodes in one grid to a next finer grid; performing the iterative smoothing operation at the next finer level; and repeating the interpolation mapping and the iterative smoothing operation until reaching the finest grid. (page 1154, column 2 - page 1155, column 2)

In reference to claims 25 and 26 drawn to articles comprising a machine-readable medium that stores machine-executable instructions causing a machine to perform the methods rejected in claims 1-23 above, the same rejection applies.

Claims 12 and 13 meet the criteria set out in PCT Article 33(2)-(3), because the prior art does not teach or fairly suggest applying different models to passive circuits exhibiting resistance and capacitance without inductance and passive circuits exhibiting inductance wherein a circuit network is represented by using a matrix of nodes having fine nodes and coarse nodes; an adaptive coarse grid construction procedure is applied to assign grid nodes in the matrix as either coarse grid nodes or fine grid nodes according to (1) circuit activities and (2) to a matrix structure of the matrix to construct a plurality of levels of grids with different numbers of nodes to respectively represent the circuit network; and iterative smoothing operations at selected local fine grids are applied corresponding to active regions at a finest level obtained in the adaptive coarse grid construction procedure.